

## SINGLE COIL TWO OPERATOR CONTROLLER

### BACKGROUND OF THE INVENTION

This invention relates to a single coil, two operator controller, and in particular to a single coil, two operator controller for gas valves, and gas valves incorporating such a controller.

There are a number of instances where it is desirable to simultaneously operate two devices. For example, operating the main valve and the redundant valve in a conventional gas valve. This is most commonly achieved by simultaneously operating two controllers, for example, two solenoids. Even if it were possible to operate the members with a single coil, the size and expense of a single coil to operate two operators would result in little, if any, savings.

### SUMMARY OF THE INVENTION

The present invention relates to a single coil, two operator controller for simultaneously actuating two spaced apart magnetically responsive operators. The controller is particularly useful in conventional gas valves having a main and redundant valves, but which is applicable to other systems where it is desirable to simultaneously or nearly simultaneously operate two members. Generally, the controller comprises a bar extending between the spaced apart operators and a coil on the bar between the operators for creating a magnetic field for moving the magnetically responsive operators. There is preferably also a plate extending between the spaced apart operators to form a substantially closed flux path through the bar, the plate, and the two controllers, to facilitate the actuation of the magnetically responsive operators.

In the preferred embodiment, the single coil comprises first and second windings, and there is a return between the first and second coils, extending between the bar and the plate, forming two separate closed magnetic flux paths, each containing one of the operators. This allows a reduction in the overall size of the coil needed to actuate the two operators, resulting in reduction in material used and in cost of the controller. These and other features and advantages will be apparent in the detailed description of the invention.

**BRIEF DESCRIPTION OF THE DRAWINGS**

Fig. 1 is a longitudinal cross sectional view of a single coil, two operator controller of the present invention, shown as it would be incorporated into a conventional two-valve gas valve;

Fig. 2 is an enlarged longitudinal cross sectional view of the single coil, two operator controller of the present invention;

Fig. 3 is an enlarged longitudinal cross section view of the single coil, two operator controller of the present inventions, with its cover removed;

Fig. 4A is a side elevation view of the controller with the cover removed, showing the operations in position when the valve is closed;

Fig. 4B is a side elevation view of the controller with the cover removed, showing the operations in position when the valve is open;

Fig. 5 is a side elevation view of a gas valve incorporating a single coil, two operator controller of the present invention;

Fig. 6 is a top plan view of the gas valve.

Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

**DETAILED DESCRIPTION OF THE INVENTION**

A single coil, two operator controller of the present invention, indicated generally as 20, is shown in Fig. 1 as it would be mounted on a conventional gas valve 24. The conventional gas valve 24 includes an inlet 26 and an outlet 28, a main valve 30 and an auxiliary valve 32, and a pressure regulator 34. When both the main valve 30 and the auxiliary valve 32 are open, the gas valve 22 provides gas from the inlet 26 to the outlet 28 at a pressure determined at least in part by the regulator 34. When either the main valve 30 or the auxiliary valve 32 is closed, gas does not flow through the gas valve 22.

The main valve 30 has a magnetically responsive operator 36 that reciprocates inside a closed-end sleeve 38. The sleeve 38 projects upwardly from the top surface of the gas valve 22. The reciprocating movement of the operator 36 opens and closes the main valve 30. Similarly, the auxiliary valve 32 has a magnetically responsive operator 40 that reciprocates inside a closed-end sleeve 42. The sleeve 42 projects

upwardly from the top surface of the gas valve 22. The reciprocating movement of the operator 36 opens and closes the auxiliary valve 32.

The controller 20 comprises a bar 44 extending between the spaced apart operators 36 and 40. The underside of the bar 44 has recesses 46 and 48 for receiving the closed ends of the sleeves 38 and 42.

There is a coil 50 on the bar 44 of a flux-conducting material. The coil 50 comprises first and second winding sections 52 and 54 wound on a plastic core 56. The plastic core 56 has a first bobbin section 58 for the first winding section 52 and a second bobbin section 60 for the second winding section 54. As shown in the drawings and described herein, the first and second winding sections are unequal in size, although the sizes of the two winding sections depends upon their application, and thus, their relative sizes may differ in different applications.

A plate 62 extends substantially between the spaced apart operators 36 and 40. In the preferred embodiment, the plate 62 has openings 64 and 66 through which the sleeves 38 and 42 extend. The operators 36 and 40 are sized and positioned so that when the coil 50 is not energized, the operators form gaps G1 and G2 between the bar 44 and the plate 62, and when the coil is energized, the magnetic force moves the operators to close the gaps G1 and G2 and form a substantially continuous flux path through bar 44, operator 36, plate 62, and operator 38. The movement of the operators 36 and 40 to close the gaps G1 and G2 opens the main and auxiliary valves 30 and 32. There are small gaps between the plate 62 and the actuators and between the bar 44 and the actuators, but these are generally negligible.

In accordance with the preferred embodiment of this invention, a return 68, positioned between the first and second winding sections 52 and 54, extends between the bar 44 and the plate 62, providing an alternate flux path so that when the coil 50 is energized, two parallel paths L1 and L2 are formed, the first, L1, comprising operator 36, a portion of the plate 62, and the portion of the bar 44 over which the first winding section 52 lies, and the second, L2, comprising the return 68. In the preferred embodiment, the return 68 is a U-shaped member, arranged so that the bottom of the "U" extends over the bar 44, and the legs of the "U" are adjacent the plate, preferably fitting into slots 70 in the plate. The core 56 creates a small gap between the inside of the bottom of the "U" of the return, and the bar 44. A portion of the core 56 could be cut away to between the bobbin section to reduce or eliminate the gap.

As shown in Fig. 3, rather than a single path L with two gaps, G1 and G2, the return 64 provides two paths, L1 and L2, to substantially eliminate gap g1. Thus, the total size of the coil (in terms of number of turns) can be reduced. For one particular configuration of gas valve, it was determined that a single coil operating in a single path L would need 3600 turns to actuate the operators, and close the gaps G1 and G2, but that a single coil with two paths, L1 and L2, would need only 2700 turns in order to actuate the actuators and close the gaps G1 and G2.

In the particular gas valve design shown and described herein, the force required to operate the primary valve is substantially less than the force required to operate the auxiliary valve. Moreover, the gap G1 that defines the travel of operator 36 (about 0.05 inches) is approximately 1/3 of the gap G2 that defines the travel of the operator 50 (about 0.150 inches). Since path L2 substantially shunts gap G1 and path L1, the total gap is reduced by gap G1 (about 25 percent) such that the second winding section needs 2700 turns to actuate the operator 40 to close the gap G2.

In operation, when the coil 50 is energized, the magnetic force created by the second winding section 54 in path L2 moves the operator 40, closing the gap G2 and opening the auxiliary valve. The magnetic force created by the second winding, particularly after the second gap G2 is closed, also moves the operator 36, closing the gap G1 and opening the primary valve. The first winding 52 is not necessary to actuate the much lower force operator 36, but improves its actuation with only 200 turns.

The controller 20 is preferably enclosed in a housing 71. The controller 20 preferably also includes a switch 74 for selectively powering the coil 50 to open and close the gas valve. The switch 74 includes a switch member 76 pivotally mounted in the housing 72 to operate between the first and second positions. The switch member 76 is resiliently biased with an overcenter spring mechanism to retain the switch in its position until it is affirmatively operated to the other position. When the gas valve 22 is connected to a gas line, and the controller connected to a system via contacts 78 and 80, the controller 20 opens the gas valve 22 in response to applied power from the system when switch 74 is "on," but does not open the gas valve in response to applied power from the system when the switch is "off."

The controller 20 thus economically operates both the main valve 30 and the auxiliary valve 32 of the gas valve with a single coil, and in the preferred embodiment

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